Available: https://doi.org/10.54117/ijnfs.v3i4.67 *Research article*

IPS Journal of Nutrition and Food Science
IPS J Nutr Food Sci, 3(4): 262-266 (2024)
DOI: https://doi.org/10.54117/ijnfs.v3i4.67

Nutritional Composition of Proximate, Mineral, Vitamin, and Amino Acid Profiles in Turmeric and Ginger from Rumuokoro Market, Port Harcourt

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Abstract

A comprehensive nutritional analysis was conducted on the proximate, mineral, vitamin, and amino acid profiles of turmeric and ginger obtained from Rumuokoro market, Port Harcourt. The proximate, mineral, vitamin, and amino acid composition of turmeric and ginger were analyzed using standard methods. The vitamin A content in turmeric and ginger were 17.93±0.594mg/kg and 29.26±0.38mg/kg respectively. Vitamin C content in turmeric and ginger were 59.49±0.66mg/kg and 50.33±0.88mg/kg while vitamin D levels were 6.0±0.10mg/kg2.93 and 2.62±0.11mg/kg respectively. Magnesium levels in turmeric and ginger were 5.76±0.05mg/kg and 6.46±0.05mg/kg respectively. Potassium concentrations in turmeric and ginger were 7.42±0.04g/100g.protein and 6.76±0.04g/100g.protein respectively while calcium levels were 4.91±0.02mg/kg and 5.55±0.49mg/Kg. The glycine content in ginger and turmeric were 4.05±0.226g/100g.protein and 3.58±0.27g/100g.protein respectively while methionine levels were 1.51±0.07g/100g.protein and1.09±0.01g/100g.protein. The mean glutamate levels in ginger and turmeric were 13.76±0.01g/100g.protein and 14.28±0.27g/100g.protein, while cysteine levels were 2.40±1.89g/100g.protein and 1.41±0.02g/100g.protein respectively. The analyzed spices are rich in essential vitamins, minerals, and amino acids, which are crucial for maintaining well-being. The high levels of vitamin C and suggest potential benefits for immune function, skin health, and antioxidant activity. The presence of lysine and valine indicates that these spices could be beneficial in complementing protein intake in populations with limited access to diverse protein sources.

Keywords: *Turmeric, ginger, amino acids, vitamins, minerals, Rumuokoro market*

Article History
Received: 05 Oct 2024
Accepted: 24 Oct 2024
Published: 29 Oct 2024

Scan QR code to view•

How to cite this paper: Onyema, J. O., Onyeike, E. N., & Amadi, B. A. (2024). Nutritional Composition of Proximate, Mineral, Vitamin, and Amino Acid Profiles in Turmeric and Ginger from Rumuokoro Market, Port Harcourt. *IPS Journal of Nutrition and Food Science*, *3*(4): 262-266. https://doi.org/10.54117/ijnfs.v3i4.67.

1. Introduction

Spices are commonly used in culinary practices for their flavor, color, and preservative properties, but they also offer substantial nutritional and health benefits. The proximate, mineral, vitamin, and amino acid composition of spices play a crucial role in their nutritional value. The proximate composition of spices includes moisture, crude protein, crude fat, crude fiber, ash, and carbohydrate content, which are essential for understanding their nutritional and caloric contributions. Studies, such as those by Akinola *et al.* (2014), have reported the proximate composition of various spices like garlic, ginger, and curry leaves, demonstrating that these spices are rich in carbohydrates and contain moderate amounts of protein and fat. Similarly, Olawuyi *et al.* (2013) found that spices such as pepper and turmeric have high moisture and carbohydrate content, making them significant sources of energy.

Spices are rich sources of essential minerals like calcium, magnesium, iron, zinc, and potassium, which are crucial for various metabolic processes. Minerals also contribute to the antioxidant capacity of spices, helping to neutralize free radicals in the body. Mohammed *et al.* (2017) conducted an analysis of selected spices and found that ginger and turmeric contained high levels of potassium, which is important for maintaining fluid balance, nerve function, and muscle contractions. Furthermore, Singh *et al.* (2015) identified significant amounts of iron and calcium in coriander and cumin, contributing to their value in anemia prevention and bone health, respectively.

Spices are also known for their vitamin content, particularly vitamins C, A, E, and B-complex vitamins. These vitamins act as antioxidants and are essential for immune function, skin health, and metabolic processes. A study by Maji *et al.* (2016) demonstrated that spices like cloves and pepper are rich in vitamin C, contributing to their antioxidant properties and role in immune function. Additionally, Joshi *et al.* (2018) showed that paprika and chili powder are rich in vitamin A, which is crucial for vision, skin health, and immune system support.

Amino acids are the building blocks of proteins, and the profile of essential and non-essential amino acids in spices is important for understanding their role in protein synthesis and other physiological processes. Ahmed *et al.* (2019) analyzed the amino acid profiles of selected spices and reported that ginger and garlic contain significant levels of essential amino acids like lysine, leucine, and valine, which are important for muscle protein synthesis and tissue repair. Similarly, Ekanayake and Thilakarathna (2015) highlighted the presence of high levels of glutamic acid and aspartic acid in spices like coriander and turmeric, which enhance the flavor of food and contribute to metabolic processes.

The rich proximate, mineral, vitamin, and amino acid content of spices contribute significantly to their health-promoting properties. For example, ginger is known for its anti-inflammatory and antioxidant properties, largely due to its rich vitamin and mineral content (Prakash *et al.*, 2017). Similarly, garlic has been shown to reduce blood pressure and cholesterol levels due to its sulfur-containing amino acids (Ried *et al.*, 2016). The comprehensive nutritional analysis of spices also highlights their role in preventing chronic diseases such as cardiovascular diseases, diabetes, and cancer. Curry leaves, for instance, are known for their high levels of vitamins A and C, contributing to their antioxidant and anti-diabetic properties (Singh *et al.*, 2015).

Local markets often offer a variety of spices that have not been comprehensively analyzed for their nutritional content. Research specific to spices purchased from markets such as Rumuokoro Market in Port Harcourt is limited, but local studies are vital for determining how environmental conditions and agricultural practices affect the nutrient composition of spices. Oboh *et al.* (2018) studied the proximate and mineral content of spices sold in local Nigerian markets and found variations in nutritional profiles based on the region of cultivation and post-harvest handling practices. This suggests that a localized study of Rumuokoro Market spices could reveal unique nutritional benefits important for consumers in the region.

2. Materials and Methods

2.1 Nature/Sources of Sample

Turmeric and Ginger was bought from the local market in Rumuokoro, sun dried and milled to fine powder.

2.2 Collection/Preparation of Samples

The ginger and turmeric samples were washed and cut into tiny sizes and air dried for 2 weeks, then blended into a fine powdered form and stored in an airtight container.

2.3 Chemicals/Reagents

Chemicals/reagents used for the present study were purchased from commercial vendors and are of analytical grade.

2.4 Proximate Analysis

The moisture level was determine through evaporation in an oven to attain unchanged mass. Total ash of the sample was evaluated by weighing and the values was then changed into dry ash in a swaddle forge (550°C). Crude fat amount was characterized through hexane extraction by adopting a Soxhlet extractor. Other analyses performed were based on AOAC (1987). Kjeldahl principle and procedure were employed in the quantification of protein concentration. Carbohydrate concentration was estimated by taking the disparity between the sums of all the proximate concentrations from 100%. Calorie readings were garnered by multiplication of the carbohydrate, protein and lipid by the Atwater conversion factors of 17, 17 and 37, respectively (Brams SJ, Kilgour, 1987).

2.5 Minerals Analysis

Mineral contents of the sample was determined based on Martin-Prevel *et al*. (1984) method. Iron, phosphorus, copper, lead, cobalt, nickel, molybdenum, iodine, selenium, manganese including zinc were evaluated colorimetrically. The levels of each metallic ion in the plant's aerial parts computed on a crispy weight base.

2.6 Amino Acid Analysis

Amino acid contents was analyzed based on the Vázquez-Ortiz *et al.* (1995) method. Powdered samples, 5mg were hydrolyzed using chloride acid (6 M) to break down proteins into their constituent amino acids. Succeeding hydrolysis, the acidic component was evaporated to dryness by mean of rotary evaporator. The mixture was resuspended in 3 milliliters of a trisodium citrate ($Na_3C_6H_5O_7$) cushion (PO_4^{3-}) at pH 2.2. Sample derivatization was achieved by adding 7.5 millimoles of o-phthalaldehyde to the specimen in a borate reagent. High performance liquid chromatography method was pegged by external and internal standards. The amino acid standard is made up of fifteen amino acids, utilized to estimate elusion timing for the various proteins. As well, internal standard αaminobutyric was introduced into protein reference standard and specimen in order to normalize as well as determine the protein concentration. A slope moving region of CH_3COONa including CH_3OH elute specimen for protein detachment conduit C_{18} column reversed-phase $C_{22}H_{48}OSi$ particles. Fluorescence discrement was garnered by an excitation-emission wavelength of 360 and 455 nm respectively. Star Chromatography work station (Varian version 5.51) software ensue adopted to attain protein peak integration. The amino acid level of the specimen was characterized in order to guessimate the protein content high performance liquid chromatography by employing Micro Kjeldahl method (AOAC,1990).

2.7 Vitamin Analysis

2.7.1 Preparation of standard vitamin solution

The standard emulsion vitamin C, B1, B3, B5 and B6 and were composed through dissolution of 20mg of the each standard in 1 ml of 0.1M chlorate acid in volumetric flask. For composing the standard mixture of vitamin B9 and B2, 20mg of the each standard were mixed 0.1 M NaOH in 25ml volumetric container. The standard was kept in a refrigerator (4°C). The working standards were composed through dilution using phosphate buffer (pH 5.2).

2.7.1.1 Preparation of sample solution

The samples were cleansed using running tap water. Plant specimen were lacerated into tiny unit, iced using liquid nitrogen (−20°C). Exactly, 1g each of iced specimen was kept in 10ml water and extricated uing 1 ml 0.1M sodium hydroxide and 10 ml PO42- (pH 5.5) for 24 hrs. The mixture was percolated using a Whatman filter paper. The filtrate was delivered in a 25 ml vacuum flask and filtrate, covered adopting HPLC grade water. The covered filtrate solution was again cleansed through 0.45µm membrane filter before inserting into liquid chromatography system and the stock was kept a refrigerator for further use.

2.7.1.2 Chromatographic analysis of water soluble vitamins

Chromatographic examination was analyzed employing the Seal *et al.* (2017) method. The mobile phase contains acetonitrile and 0.01% v/v aqueous trifluoro acetic acid (A and B), the column was thermostatically regulated at a constant temperature while the insertion volume was presented at 20µl. A slope elutriate was displayed by changing the amount of liquid A to solvent B. Whole characterization period for each specimen was 20 min. Chromatograms of all the vitamins were captured employing a UV light at 290nm. Identification of the analyte was performed in same manner that followed spotting of phenolic acids and flavonoids, while data were reported as means ± standard error (n=3).

2.8 Statistical Analysis

All data constituted as means ± standard deviation, were scrutinized employing Statistical SPSS (window version 17.0). Illustrative data were carried out through one way ANOVA and multiple comparison was performed adopting Turkey Post hoc at (p≤0.05) confidence interval.

3. Results and Discussion

High levels of vitamin A in spices can have several nutritional and health implications, both beneficial and potentially harmful, depending on consumption patterns. Vitamin A is an essential nutrient with roles in vision, immune function, skin health, and antioxidant defense (Gropper et al., 2016). In table 1, the vitamin A content was noticed to be highest in ginger while the least was turmeric and that of vitamin E was high in turmeric than it was in ginger (Table 1). The vitamin A and E levels observed in turmeric and ginger is indicative that these spices could play crucial in maintaining healthy vision, immune defenses, cell differentiation, prevent chronic cardiovascular diseases and cancer growth. The vitamin C scrutinized in turmeric was high when compared to that of ginger and the vitamin D in turmeric was higher that of ginger (Table 1). The presence of high levels of vitamin C and vitamin D in local spices evaluated in this study is reflective that they could have significant health and nutritional implications including physiological functions and their abundance in the studied spices could enhance the nutritional value of a diet, particularly in regions where these nutrients might be otherwise deficient.

Table 1: Vitamin and proximate composition of selected local spices purchased from Rumuokoro market, Port Harcourt (n=3).

Nutrients	Turmeric	Ginger
Vitamin A (mg/kg)	17.93 ± 0.594^{a}	29.26 ± 0.38^{c}
Vitamin E (mg/kg)	15.97 ± 0.232^{b}	3.63 ± 0.17^{a}
Vitamin C (mg/kg)	59.49 ± 0.66^{b}	50.33 ± 0.88^{a}
Vitamin D (mg/kg)	6.03 ± 0.10^{c}	2.62 ± 0.11^{a}
Vitamin B1 (mg/100g)	0.17 ± 0.00^{c}	0.13 ± 0.00^{a}
Vitamin B2 (mg/100g)	0.16 ± 0.00	0.16 ± 0.00
Vitamin B3 (mg/100g)	0.59 ± 0.02^{b}	0.76 ± 0.02^{c}
Vitamin B6 (mg/100g)	0.24 ± 0.00^{b}	0.23 ± 0.00^{b}
Vitamin B12 (mg/100g)	5.01 ± 0.78	3.18 ± 0.10
% moisture	5.92 ± 0.06^{b}	5.497 ± 0.03^{a}
% fat	9.44 ± 0.17^{b}	4.98 ± 0.13^{a}
% ash	7.95 ± 0.13^{a}	8.16 ± 0.06^{c}
% fibre	1.16 ± 0.13^{a}	1.62 ± 0.10^{b}
% Protein	10.27 ± 0.20^{b}	8.17 ± 0.20^{a}
% Carbohydrate	65.2 ± 0.22^{b}	71.58 ± 0.19^{c}

Values are expressed as mean ± SD. (n= 3 replicates). Means in same row with the same superscript Alphabets are not significantly different at p<0.05, while means in same row with different superscript alphabets are significantly different at p<0.05

The presence of significant amounts of vitamin B1 (thiamine), B2 (riboflavin), and B3 (niacin) in local spices can provide several health benefits due to their essential roles in energy metabolism, neurological function, and overall cellular health. These B vitamins, commonly known as part of the B-complex group, are water-soluble and play a central role in converting food into energy, supporting proper brain function, and maintaining skin and heart health (Butterworth, 2003; Lonsdale, 2006; Ashoori and Saedisomeolia, 2014). The vitamin B_1 examined in turmeric was seen to be higher than that of ginger while vitamin B2 of both turmeric and ginger are not significantly different. (Table 1). The vitamin B_{12} examined in turmeric and ginger were higher than the recommended daily intake of vitamin B_{12} as reported by National Institutes of Health (2021), hence could play crucial role in energy metabolism, neurological function, and cellular health. Studying the proximate composition of local spices is essential for understanding their nutritional contribution to diets, particularly in regions where spices are used extensively for both culinary and medicinal purposes. The moisture content of turmeric was observed to be higher than ginger. The fat content in turmeric was higher than that of ginger. The ash content in ginger was significantly higher than that of turmeric. The fiber in ginger was observed to be higher than that of turmeric. The protein in turmeric was higher than in ginger. The carbohydrate in ginger was much more higher than that of turmeric respectively. The moisture, ash, fibre, and protein contents scrutinized in this study were slightly higher than the values reported by Siddhuraju and Becker (2003) on the nutritional and antioxidant properties of turmeric, ginger, and pepper. Improved moisture, fiber, and ash contents in local spices could have positive implications for nutritional value, health benefits, and preservation. Proper moisture control can extend shelf life, increased fiber enhances digestive health, and higher ash content ensures that essential minerals are supplied in adequate amounts. Understanding these proximate parameters is vital for promoting the use of local spices in both culinary and medicinal applications

Table 2 shows the mineral composition of turmeric and ginger purchased from Rumuokoro market Port Harcourt. The mineral content of spices plays a significant role in their nutritional and health benefits. Minerals are essential nutrients that contribute to various physiological functions, including enzyme activation, nerve transmission, bone formation, and immune function. Local spices are known to be rich in a variety of essential minerals such as calcium, potassium, iron, zinc, and magnesium (Mohammed *et al.*, 2017; Ghorbani and Esmaeilizadeh, 2017). The copper in turmeric was higher than that of ginger. The Fe level in turmeric was higher than that in ginger while that of Zn in turmeric and ginger. Also, the Mg level in ginger was significantly higher than that of turmeric The Na concentration in turmeric was examined to be higher than that of ginger. The K level in turmeric ginger. The Ca scrutinized in ginger was seen to be higher. The concentrations of Cu, Fe, Zn, Mg, Na, K, and Ca evaluated in turmeric and ginger were lower than the values reported by Mohammed *et al.* (2017) on the mineral content of commonly used spices in local markets. However, the concentrations of these examined minerals could contribute to essential functions including bone health, immune support, and metabolic processes. More so, including these spices in the diet might significantly improve the intake of crucial minerals needed for maintaining overall health.

Table 2: Mineral composition of selected local Spices purchased from Rumuokoro market (n=3)

Groups	Turmeric	Ginger
Copper (ppm)	0.59 ± 0.001[b]	0.48 ± 0.01 [c]
Iron ppm	2.10 ± 0.0 [b]	1.67 ± 0.01 [c]
Zinc ppm	0.43 ± 0.00 [b]	0.41± 0.00 [c]
Magnesium	5.76 ± 0.05 [b]	6.46± 0.05 [c]
Sodium ppm	5.18 ± 0.13 [ab]	4.89 ± 0.01[b]
Potassium ppm	7.42 ± 0.04 [a]	6.76 ± 0.04 [a]
Calcium ppm	4.91 ± 0.02[ab]	5.55 ± 0.49[b]
Chromium ppm	0.06 ± 0.00 [b]	0.13 ± 0.01 [c]
Lead ppm	0.19 ± 0.00[b]	0.19± 0.01 [b]
Cobalt ppm	0.03± 0.00 [b]	0.12 ± 0.00 [c]
Cadmium ppm	0.05± 0.00 [b]	0.07 ± 0.00 [c]
Manganese ppm	0.07± 0.00[b]	0.05 ± 0.00 [b]
Selenium ppm	0.15 ± 0.00 [a]	0.06 ± 0.00 [b]
Aluminum ppm	ND	ND
Nickel ppm	0.02 ± 0.00 [b]	0.01 ± 0.00 [b]
Arsenic ppm	ND	0.003 ± 0.001
Molybdenum ppm	0.022± 0.00 [a]	0.07 ± 0.01[b]
Tin ppm	ND	ND

Values are expressed as mean ± SD. (n= 3 replicates). Means in same row with the same superscript Alphabets are not significantly different at p<0.05, while means in same row with different superscript alphabets are significantly different at p<0.05.

Table 3 indicates the amino acid contents of turmeric and ginger in selected spices purchased from Rumuokoro market, Port Harcourt. Amino acids are vital components of proteins and play significant roles in various physiological functions in both plants and humans. The amino acid composition of spices not only contributes to their nutritional value but also influences their flavor and health benefits. Ramesh and Sharma (2016) in their study on amino acid composition of ginger (*Zingiber officinale*) and its health benefits, reported glutamic acid (6.8 g/100 g), asparagine (1.5 g/100 g), arginine (0.57 g/100 g), and lysine (0.58 g/100 g). Kurien *et al.*. (2015) in their review on nutritional and medicinal value of turmeric reported that turmeric contain glutamic acid (6.58 g/100 g), aspartic acid (5.02 g/100 g), lysine (0.81 g/100 g), and methionine (0.31 g/100 g).

Table 3: Amino acid contents of selected spices Purchased from Rumuokoro Market, Port Harcourt (n=3)

Amino Acids (g/100g Protein)	Ginger	Turmeric
Glycine	1.36 ± 0.18	4.05 ± 0.226
Alanine	1.85 ± 0.00	4.89 ± 1.98
Serine	1.56 ± 0.02	4.13± 0.09
Proline	3.89 ± 0.28	3.83± 1.06
Valine	1.77 ± 0.03	4.14 ± 0.07
Threonine	4.08± 0.71	4.29 ± 0.14
Isoleucine	1.67 ± 0.25	4.20 ± 0.13
Leucine	7.74± 0.13	7.60 ± 0.84
Aspartate	1.84 ± 0.07	0.90± 0.35
Lysine	6.85 ± 0.00	7.85 ± 2.17
Methionine	1.51 ± 0.07	1.09 ± 0.01
Glutamate	13.76 ± 0.01	14.28 ± 0.27
Phenylalanine	3.67± 0.10	4.12 ± 1.46
Histidine	0.87 ± 0.16	2.69 ± 0.58
Arginine	2.82 ± 0.11	5.77± 1.11
Tyrosine	3.16 ± 0.33	3.11 ± 0.27
Tryptophan	1.12 ± 0.94	1.06 ± 0.03
Cystine	2.40 ± 1.89	1.41 ± 0.02

Values are expressed as mean ± SD. (n= 3 replicates). Means in same row with the same superscript Alphabets are not significantly different at p<0.05, while means in same row with different superscript alphabets are significantly different at p<0.05.

In this study, the glycine, alanine, serine and valine in turmeric was higher than that of ginger while proline and threonine in ginger was significantly than that of turmeric respectively (Table 3). Also, the isoleucine lysine, glutamate and phenylalanine content examined in turmeric was higher than that in ginger respectively while the leucine, aspartate, and methionine content in ginger was ultimate followed by turmeric.

The histidine and arginine contents in turmeric was observed to be higher than that of ginger respectively. The tyrosine, tryptophan, cysteine contents in ginger was observed to be higher than that of turmeric. The concentration of glutamate, arginine, alanine, and lysine examined in this study were higher than the values reported by Ramesh and Sharma (2016) shown above. The studied glutamate, arginine, alanine, and lysine threonine, leucine, lysine, methionine, phenylalanine, arginine, tyrosine, tryptophan, tyrosine, and cysteine in turmeric and ginger diets could enhance their nutritional value and might contributes to various health benefits. These amino acids could be supportive to energy production, muscle metabolism, cognitive function, skin health, and immune response, making these local spices valuable dietary components. Incorporating marijuana, turmeric, and ginger into the diets could be beneficial for individuals seeking to improve their overall health and nutritional status.

4. Conclusion

This comprehensive nutritional analysis of the proximate, mineral, vitamin, and amino acid profiles of selected spices from the Rumokoro market in Port Harcourt underscores their significant nutritional potential. The analyzed spices display a rich composition of essential nutrients, including vitamins, minerals, and amino acids, which are vital for maintaining overall health and well-being. High levels of certain vitamins, such as vitamin C and vitamin A, suggest potential benefits for immune function, skin health, and antioxidant activity. The presence of essential amino acids, such as lysine and valine, indicates that these spices can help complement protein intake, especially in populations with limited access to diverse protein sources, thereby improving dietary quality. The substantial levels of essential minerals found in these spices contribute to various physiological functions, including bone health, metabolic processes, and electrolyte balance. This analysis reinforces the value of incorporating these spices into daily diets to help meet mineral requirements.

Declarations

Competing Interest

The authors declare no competing interest.

Authors' Contributions

All listed authors contributed equally to the research process, literature writing, review and editing of the article.

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